

What is claimed is:

1. A membrane, comprising an elastomeric material, a polymeric fluid barrier material, and a laminar nano-filler having an average platelet thickness of up to about 10 nanometers and an average aspect ratio of at least about 200.
2. A membrane according to claim 1, comprising a mixture of the laminar nano-filler and the polymeric fluid barrier material.
3. A membrane according to claim 2, wherein the mixture is distributed in a continuous matrix of the elastomeric material.
4. A membrane according to claim 1, wherein the elastomeric material is selected from the group consisting of polyurethane elastomers, flexible polyolefins, styrenic thermoplastic elastomers, polyamide elastomers, polyamide-ether elastomers, ester-ether and ester-ester elastomers, flexible ionomers, thermoplastic vulcanizates, flexible poly(vinyl chloride) homopolymers and copolymers, flexible acrylic polymers, and combinations thereof.
5. A membrane according to claim 1, wherein the elastomeric material is selected from the group consisting of thermoplastic polyester-polyurethanes, thermoplastic polyether-polyurethanes, thermoplastic polycarbonate-polyurethanes, and combinations thereof.

6. A membrane according to claim 1, wherein the polymeric fluid barrier material is selected from the group consisting of ethylene-vinyl alcohol copolymers, poly(vinyl chloride), polyvinylidene polymers and copolymers, polyamides, acrylonitrile polymers, polyurethane engineering plastics, poly(methyl pentene) resins, ethylene-carbon monoxide copolymers, liquid crystal polymers, polyesters, polyimides, and combinations thereof.
7. A membrane according to claim 1, wherein the polymeric fluid barrier material comprises an ethylene-vinyl alcohol copolymer.
8. A membrane according to claim 1, wherein the laminar nano-filler has an average thickness of from about 1 nm to about 10 nm and an aspect ratio from about 200 to about 1000.
9. A membrane according to claim 1, wherein the laminar nano-filler is a montmorillonite clay.
10. A membrane according to claim 1, wherein the membrane comprises from about 4 to about 10 weight percent of the laminar nano-filler.
11. A permanently sealed, inflated bladder comprising a membrane according to claim 1.

12. A permanently sealed, inflated bladder comprising a membrane according to claim 2.

13. A membrane, comprising at least one elastomeric layer comprising an elastomeric material and at least one barrier layer comprising a polymeric fluid barrier material, wherein at least one of the membrane layers further comprises a laminar nano-filler having an average platelet thickness of up to about 10 nanometers and an average aspect ratio of at least about 200.

14. A membrane according to claim 13, wherein the elastomeric material is selected from the group consisting of polyurethane elastomers, flexible polyolefins, styrenic thermoplastic elastomers, polyamide elastomers, polyamide-ether elastomers, ester-ether and ester-ester elastomers, flexible ionomers, thermoplastic vulcanizates, flexible poly(vinyl chloride) homopolymers and copolymers, flexible acrylic polymers, and combinations thereof.

15. A membrane according to claim 13, wherein the elastomeric material is selected from the group consisting of thermoplastic polyester-polyurethanes, thermoplastic polyether-polyurethanes, thermoplastic polycarbonate-polyurethanes, and combinations thereof.

16. A membrane according to claim 13, wherein the polymeric fluid barrier material is selected from the group consisting of ethylene-vinyl alcohol

copolymers, poly(vinyl chloride), polyvinylidene polymers and copolymers, polyamides, acrylonitrile polymers, polyurethane engineering plastics, poly(methyl pentene) resins, ethylene-carbon monoxide copolymers, liquid crystal polymers, polyesters, polyimides, and combinations thereof.

17. A membrane according to claim 13, wherein the polymeric fluid barrier material comprises an ethylene-vinyl alcohol copolymer.

18. A membrane according to claim 13, wherein the laminar nano-filler has an average thickness of from about 1 nm to about 10 nm and an aspect ratio from about 200 to about 1000.

19. A membrane according to claim 13, wherein the laminar nano-filler is a montmorillonite clay.

20. A membrane according to claim 13, wherein the membrane comprises from about 4 to about 10 weight percent of the laminar nano-filler.

21. A permanently sealed, inflated bladder comprising a membrane according to claim 13.

22. A permanently sealed, inflated bladder comprising a membrane according to claim 15.

23. A permanently sealed, inflated bladder comprising a membrane according to claim 17.

24. A permanently sealed, inflated bladder comprising a membrane according to claim 18.

25. A permanently sealed, inflated bladder comprising a membrane according to claim 20.

26. A bladder according to claim 21, wherein said bladder is inflated with a gas comprising nitrogen.

27. A bladder according to claim 24, wherein said bladder is inflated with a gas comprising nitrogen.

28. A bladder, comprising an elastomeric barrier membrane, wherein:
said membrane comprises a microlayer polymeric composite layer having at least about 10 microlayers, each microlayer individually being up to about 100 microns thick, said microlayers alternating between at least one polymeric gas barrier material and at least one elastomeric material;
and further wherein said microlayers of polymeric fluid barrier material or said microlayers of elastomeric material or both comprise a laminar nano-filler

having an average platelet thickness of up to about 10 nanometers and an average aspect ratio of at least about 200.

29. A bladder according to claim 28, wherein the microlayers of polymeric fluid barrier material comprise the laminar nano-filler.

30. A bladder according to claim 28, wherein said elastomeric material comprises a member selected from the group consisting of polyurethane elastomers, flexible polyolefins, styrenic thermoplastic elastomers, polyamide elastomers, polyamide-ether elastomers, ester-ether elastomers, ester-ester elastomer, flexible ionomers, thermoplastic vulcanizates, flexible poly(vinyl chloride) homopolymers and copolymers, flexible acrylic polymers, and combinations thereof.

31. A bladder according to claim 28, wherein said elastomeric material includes a polyurethane elastomer.

32. A bladder according to claim 28, wherein said elastomeric material includes a member of the group consisting of thermoplastic polyester diol-based polyurethanes, thermoplastic polyether diol-based polyurethanes, thermoplastic polycaprolactone diol-based polyurethanes, thermoplastic polytetrahydrofuran diol-based polyurethanes, thermoplastic polycarbonate diol-based polyurethanes, and combinations thereof.

33 A bladder according to claim 32, wherein the elastomeric material comprises a thermoplastic polyester diol-based polyurethane.

34. A bladder according to claim 33, wherein the polyester diol of said polyurethane is a reaction product of a mixture comprising at least one dicarboxylic acid, dicarboxylate ester, or anhydride selected from the group consisting of adipic acid, glutaric acid, succinic acid, malonic acid, oxalic acid, anhydrides of these acids, and mixtures thereof and at least one diol selected from the group consisting of ethylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, propylene glycol, dipropylene glycol, tripropylene glycol, tetrapropylene glycol, 1,3-propanediol, 1,4-butanediol, neopentyl glycol, 1,5-pentanediol, 1,6-hexanediol, and mixtures thereof.

35. A bladder according to claim 28, wherein the fluid barrier material comprises a member selected from the group consisting of ethylene vinyl alcohol copolymers, polyvinylidene chloride, acrylonitrile copolymers, polyethylene terephthalate, polyamides, crystalline polymers, polyurethane engineering thermoplastics, and combinations thereof.

36. A bladder according to claim 28, wherein the fluid barrier material comprises an ethylene-vinyl alcohol copolymer.

37. A bladder according to claim 28, wherein said microlayer polymeric composite includes at least about 50 microlayers.
38. A bladder according to claim 28, wherein said microlayer polymeric composite includes from about 10 microlayers to about 1000 microlayers.
39. A bladder according to claim 28, wherein said microlayer polymeric composite layer includes from about 50 microlayers to about 500 microlayers.
40. A bladder according to claim 28, wherein the average thickness of each fluid barrier material microlayer is independently from about 0.01 micron to about 2.5 microns thick.
41. A bladder according to claim 28, wherein the average thickness of the microlayer polymeric composite layer is from about 75 microns to about 0.5 centimeter.
42. A bladder according to claim 28, wherein said membrane further comprises at least one layer including an elastomeric polyurethane.
43. A bladder according to claim 42, wherein said membrane comprises further layers including an elastomeric polyurethane adjacent to either side of the microlayer polymeric composite layer.

44. A bladder according to claim 28, wherein the bladder is inflated with a gas.
45. A bladder according to claim 28, wherein said bladder is inflated with a gas comprising nitrogen.
46. A bladder according to claim 44, wherein the inflating gas is at a pressure of at least about 3 psi.
47. A bladder according to claim 28, wherein the bladder is permanently sealed.
48. A bladder according to claim 29, wherein the laminar nano-filler has an average thickness of from about 1 nm to about 10 nm and an aspect ratio from about 200 to about 1000.
49. A bladder according to claim 29, wherein the laminar nano-filler is a montmorillonite clay.
50. A bladder according to claim 29, wherein the membrane comprises from about 4 to about 10 weight percent of the laminar nano-filler.
51. A shoe, comprising at least one bladder according to claim 28.

52. A shoe according to claim 51, wherein the bladder is incorporated as a portion of said sole.
53. A shoe according to claim 51, wherein said bladder forms at least a part of an outer surface of said shoe.
54. A ball, comprising a bladder according to claim 28.